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A FIELD EXPERIMENTAL STUDY OF PROGRAMMED INSTRUCTION ON A MANIPULATIVE TASK

JOHN D. FOLLEY, JR.
AUBREY J. BOUCK

APPLIED SCIENCE ASSOCIATES, INC.

JOHN P. FOLEY, JR.

AEROSPACE MEDICAL RESEARCH LABORATORIES

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FOREWORD

This report represents a portion of the technical development program of the Technical Training Branch, Training Research Division, Behavioral Sciences Laboratory. The research was documented under Project No. 1710, "Training, Personnel, and Psychological Stress Aspects of Bioastronautics," Task No. 171004, "Techniques for Training, Aiding, and Evaluating the Performance of Technical Tasks." Dr. Gordon A. Eckstrand was the project scientist. Dr. Ross L. Morgan was task scientist. Mr. John P. Foley, Jr. was contract monitor. The research was conducted under Contract No. AF 33(657)-11358 with Applied Science Associates, Inc., Valencia, Pennsylvania. Dr. John D. Folley, Jr. was the principal investigator. Mr. Aubrey J. Bouck was the on-site representative of Applied Science Associates, Inc. Dr. Andrew P. Chenzoff of Applied Science Associates, Inc., performed the data analysis. The study was conducted in cooperation with Air Training Command at the Lackland Military Training Center. Air Training Command approval was obtained through Colonel Gabriel D. Ofiesh of Air Training Command Headquarters. The Lackland project officer was Mr. Walter E. Driskill. Research dates: August 1963 - December 1963.

This study could not have been conducted in this environment without the support, cooperation, and assistance of Lt. Col. Grafton W. Stull, Assistant Operations Officer, Lackland Military Training Center; Major Hugh V. McBride, Operations Officer, Basic Military School; Michael A. Zaccaria, PhD, Chief of the Training Evaluation Branch, Programs Control Division, LMTC Operations and of Mr. Walter E. Driskill who was the Center's Project Officer for the study. Their contributions are acknowledged with thanks. The outstanding technical competence, great skill at programming and dedication of M/Sgt. Cary B. Owens, cowriter of both the original and the revised linear programs, are deeply appreciated. Appreciation must be expressed to all of the participating personnel of the Field and Marksmanship Training Branch of the 3720th Basic Military School in whose environment this research was conducted as well as to the 1,366 basic trainees who were the subjects. The following warrant special mention:

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TSgt Clair O. Fitzgerald
SSgt Henry M. Bridges
SSgt Albert J. McMindes
SSgt Bobby G. McGee
SSgt Clarence T. Smith

This technical report has been reviewed and is approved.

WALTER F. GRETHER, PhD
Technical Director
Behavioral Sciences Laboratory

ABSTRACT

Approximately 1300 basic military trainees were used in a 3 x 7 factorial study of modes and content of training on a manipulative performance task, the assembly and disassembly of the M1 carbine. The modes of training included lecture-demonstration, a printed linear program with or without an answer sheet, and an audio-visual program presented by an audio-visual device or by a printed booklet. Also evaluated was a condition in which the trainees tried to perform the final task and were assisted as required. The content of the training was varied by providing training on assembly only, or disassembly only, or both. The final criteria were the time and the number of assists required to disassemble and assemble the M1 carbine. Although the modes of training differed significantly, the rankings were very different on the two criteria. No mode of training seemed clearly superior to the other modes. The audio-visual program presented in the printed booklet seemed somewhat inferior. Training on only the assembly of the carbine resulted in as good performance as training on both assembly and disassembly. The findings probably can be generalized only to relatively simple procedural type tasks. Replication of the study with more complex performance tasks is recommended.

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INTRODUCTION

The repair and maintenance procedures in the Air Force have undergone considerable change over the last twenty years. Preventive maintenance and inspection procedures have been refined. Human factors research findings have led to higher reliability and improved accessability for inspection, removal and replacement. The accumulation and refinement of malfunction and work-performed data under the data collection provisions of AF Reg. 66-1 have led to improved material support and closer manpower control. These changes all result in more precise definitions of the tasks included in job descriptions. Maintenance work involves more emphasis upon locating trouble and following precise procedures in the removal and replacement of the defective part than upon repair of defective components. Thus a considerable portion of the work is closely allied to skill and efficiency in the performance of disassembly and assembly tasks.

The area of interest in this research is directed at improving maintenance efficiency by determining the effectiveness of various methods of teaching manipulative skills. Although considerable research has been devoted to the relative effectiveness of methods of teaching verbal knowledge, little has been done involving the manipulative behavior required by disassembly and assembly tasks. Verbal materials, such as nomenclature, theory of operation, inspection procedures, and use of technical publications, have been taught by work books, lecture-demonstration, and programmed instruction. The laboratory or shop portions which involve the acquisition of manipulative skills have been taught by project assignments and trial and error practice. This study compares various modes of instruction in a manipulative skill.

One of the basic characteristics of programmed instruction is that confirmation of the response induced by the frame is immediate and tangible. Thus, programs have been developed in verbal terms and with verbal confirmation. Programming to teach performance skills presents a problem in this respect. If the frame or stimulus produces behavior not recognized by the student as correct, the behavior may be assumed to be unreinforced, and thus not likely to be repeated (or learned). If frames have no verbal reinforcement, is a sequence of carefully devised performance steps without verbal reinforcement likely to produce learning? If such a program does not produce learning, can reinforcement or confirmation be provided in other than verbal terms?

Another question arises in that instruction can be communicated in several ways. After the form and structure of a sequence of instructional steps have been determined, the training technologist must determine the most effective mode of presentation. Recent developments in audio-visual equipment have made available to the training technologist a broadened communication media suitable for use with programmed instruction. What relationship has the mode or modes of communication to effectiveness in learning manipulative skills?

PROBLEM

Determining the relative effectiveness of several modes of teaching a well-defined manipulative skill was the principle objective of the study. In the course of refinement of the programs, however, several by-product investigations appeared feasible and economical. These investigations as well as the principle one are stated in the following null hypotheses.

I. The performance of USAF Basic Military Trainees in dissassembly and assembly of the M1 Carbine will not differ significantly after training, between groups of trainees taught by:

A. Audio-Visual Program
B. Audio-Visual Program, Booklet Form
C. Linear Program with Answer Sheet
D. Linear Program
E. Present Method Instruction
F. No formal Instruction

II. The performance of USAF Basic Military Trainees in Disassembly and Assembly of the M1 Carbine will not differ significantly between groups taught by each of the first five modes above in sub-categories below:

A. Disassembly and Assembly
B. Disassembly only
C. Assembly only

APPROACH

General Description of the Research

This study was done in a field training environment at the Lackland Military Training Center of the USAF Air Training Command, Lackland Air Force Base, Texas. The study was arranged to fit into ongoing basic training schedules. The subjects, basic trainees, were used in groups of about 50 to 60, the size of the unit, or flight, around which the basic training is organized.

Each flight was trained on all or part of the task of disassembly and assembly of the military carbine in accordance with the assignment of the flights to the cells of the experimental design. They were tested two days later on their ability to perform the required task.

Test scores are in terms of time required to complete the task and the number of assists required before completion of the task.

Experimental Design

An analysis of variance design was used. The two independent variables were:

a. Mode of Presentation
b. Content of Training

The dependent variable was the score obtained on a performance test of disassembling and assembling the carbine.

The design is shown in Figure 1. See below for explanation of abbreviations.

	Mode of Presentation							
Content of Training	AV	AVB	LPB	LPBA	PMI_u	PMI_1	NT_1	NT_2
D + A								
D_0								
A_0								

Figure 1. Experimental Design

Mode of Presentation:

General: In all modes, each subject had a carbine and actually performed each of the steps specified in the instructions.

AV: Audio-Visual. A program of 54 frames for the total task, in which verbal instructions were given by recorded voice and illustrations given by projected 35 mm. colored slides.

AVB: Audio-Visual Book. The same program as the AV program, but in book form. Instructions were printed on the page along with a black-and-white print of the related colored slide.

LPB: Linear Program Book. A conventional Skinner-type program in book form. Instructions were printed on the page, illustrated as necessary with line drawings. Occasional written responses were required.

LPBA: Linear Program Book with Answer Sheet. The same program as LPB. Subjects were required to write their responses on a separate answer sheet. This mode was included to determine whether use of the separate answer sheet had any deleterious effect on learning. Use of a separate answer sheet eliminates consumption of the relatively expensive booklets, a factor to consider in large-scale training.

PMI_U: Present Mode of Instruction by an instructor who had little special attention from the researcher. ("Uninstructed") Lecture-demonstration essentially in the manner that had been in use at the school prior to this study.

PMI_I: Same as PMI_U, except that instructor had done several "dry runs" under the coaching of the on-site researcher.

NT_1, NT_2: No Training. The subscript one (1) designates these groups the first time they took the criterion test. NT_2 are the same groups of subjects the second time they took the test. It can be treated as though NT_1 were a training session, and NT_2 the testing session yielding scores directly comparable to the test scores obtained after other modes of presentation. In both these modes each subject received an "assist" on any procedural step he could not perform on his own.

Content:

D + A: Disassembly and Assembly. Groups in this row were taught how to disassemble the carbine and then how to assemble it.

D_O: Disassembly only. These groups were instructed only on disassembly.

A_0: Assembly only. These groups were instructed only on assembly of the carbine.

The "No Training" groups were assigned randomly to the "Content" treatment since the "No Training" groups all received the same content in taking the criterion test.

Subjects

All subjects were male USAF Basic Military Trainees in the fourth week of a training program of 5 weeks. All were non-prior-service airmen. They participated in the training and testing in Flights ranging in size from 50 to 63 airmen as a regular part of the Field and Marksmanship phase of their Basic Military Training. The Flights were pre-selected from among those available to be representative of the Basic Military population. Selection was done on the basis of mean scores of the flight on the four Aptitude Areas. Flights were rejected whose mean scores on any of the four aptitudes differed significantly (p. 05) from populational data (N = 11,196) provided by the Personnel Laboratory, Lackland Air Force Base.

Table 1 shows the population data and the range within which sample means were acceptable.

TABLE 1

POPULATIONAL NORMS* AND ACCEPTABLE SAMPLE MEANS: AIRMAN QUALIFICATION EXAMINATIONS, APTITUDES

	Mechanical	Administrative	General	Electronic
Mean	59.1	58.1	60.0	58.2
Std. Dev.	21.8	18.5	18.5	21.7
Acceptable Sample Means	53.6 - 64.6	53.4 - 62.8	56.3 - 65.7	52.7 - 63.7

*N = 11,196 Aug. 1961. No significant differences on basis of sample comparisons with 1962 and 63. From USAF, AFSC, Personnel Laboratory

All trainees who had received previous instruction on the disassembly and assembly of the M-1 Carbine were instructed to so indicate on their test record sheets.

Development of Training Materials

Some instructional program material had previously been prepared by personnel at the Lackland Military Training Center. Two experimental programs, an Audio Visual and a Linear Program book had been prepared and, of course, instruction was being given to each flight of basic trainees. The lecture-demonstration method was being used for this on-going instruction.

The initial problem was to bring the content of the three training programs (Audio-Visual, Linear Program and Present Method of Instruction) into congruity. The Audio-Visual program taught the complete disassembly and assembly of the Carbine but taught both disassembly and assembly concurrently. The original Linear Program contained sequences on nomenclature, as well as care and cleaning of the weapon, but did not teach the disassembly of the operating slide and bolt. In addition, the assembly portion of the Linear Program was not suitable for use alone in that the assembly frames presumed the disassembly repertory. The Present Method of Instruction was a Lecture-Demonstration version of the Linear Program. Table 2 shows the incongruities of the three training programs before revision.

TABLE 2

PRE-REVISION INCONGRUITIES OF THE THREE TRAINING PROGRAMS

	Existing Programs		
Content	A/V	LP	PMI
Disassembly	Taught concurrently	In sequence	In sequence
Assembly	Complete	But Incomplete	But Incomplete
Nomenclature	Taught	Taught	Taught
Care & Cleaning	Not Taught	Taught	Taught

As a first step, a performance task description was developed to serve as a precise description of the desired learning outcomes. Subject matter experts (experienced instructors) were observed disassembling and assembling the Carbine and each step of performance was listed. After the first three observations, four additional observations produced no changes to the list of performance items. (Appendix 1)

A series of conferences were then held with two instructors selected by the Section Chief to conduct the PMI. The List of Performance Items was used as the teaching objective and a standard lesson plan developed. (Appendix 2) The lesson plan was tried out by each instructor for familiarization.

The existing Linear Program was edited using the List of Performance Items as a criterion. The additional programming required was defined and the necessary frames were developed. Each sequence of frames was given intensive tryout using airmen of low aptitude. The frames numbered 120-135 in the revised program were then assembled in the previously edited Linear Program Booklet. The assembly frames were numbered 136-160 and bound separately. A short set of instructions was placed on the front of the assembly booklet.

The restructuring of the Audio Visual Program was accomplished in two steps. First, the program was put on 5 x 8 cards with the Audio printed and the pictures attached. These cards were then tried out on basic airmen. The minor revisions and resequencing required had no effect on this previously validated program. After the tryouts were completed, the program was then transferred to the tape-on-slide-holders and the presentation tryouts (described elsewhere) were conducted. The cards (with minor editing) were used as copy for the printed version of the program.

A mimeographed answer sheet with instructions was prepared for the Linear Program. (Appendix 3) This provided an alternate form of the Linear Program; i.e., the Linear Program with answer sheet.

The Equipment

The classroom was equipped with thirty-five tables. On each table top were stenciled the silhouettes and names of the parts of a disassembled M1 Carbine. Students worked at these tables in pairs during the regular four hours of classroom Marksmanship Training. The experimental groups, however, worked one man to a table during the second hour (disassembly and assembly) in every case of training and testing. The classroom was well lighted and ventilated.

Approximately 75 weapons were checked by the maintenance man for use in the experiment to insure a uniform state of repair. These same weapons were used for all groups.

The Audio Visual Programs were presented with the tape-on-slide projector manufactured by Revere. A daylight screen was used and the classroom was partially darkened. During the try-outs of the program, the classroom light conditions were varied until the balance of light on the tables and the screen was judged optimum.

EXPERIMENTAL PROCEDURE

Training

The classroom was prepared for training prior to each training session. One carbine was placed on each table. Each weapon was given an operational check at the beginning and the close of each training session. Since the ordnance repair specialist had specifically inspected and repaired the weapons used in the study, the purpose of this check was to insure that each weapon was cocked and that the front band screws were reasonably tight. Each flight (50-60 airmen) was given a brief orientation upon arrival at the classroom. The following points were covered:

a. Classroom and seating arrangement was explained.

b. That the training would cover the Disassembly and Assembly, the Disassembly Only, or the Assembly Only of the M1 Carbine.

c. That the training was being conducted as part of a special study to determine the most effective of several methods of teaching a mechanical task.

d. That the flight would be tested on the day after tomorrow but the test results would not be a part of their Basic Military Training Record.

The flight was then divided into two sections (because of the limited size of the classroom). One section moved into the classroom, the other section moved behind an adjacent building until the first section completed training. The second section then moved into the classroom. As individuals completed the self-paced programs (The AV Booklet, Linear Program and Linear Program with Answer Sheet), they were permitted to leave the classroom but not allowed to join the untrained section of the flight.

On each training day three flights were trained in two sections each. The first session and flight was given the Disassembly and Assembly version; the second flight, the Disassembly Only version; and the third flight, the Assembly Only version of the program. After the first section of the Disassembly Only flight, the weapons were assembled by instructors. After the first section of the Assembly Only flight, the weapons were disassembled by instructors.

The training, except PMI, was supervised by the Field Researcher who was assisted by one or two instructors. Student questions during training were handled as follows:

a. Requests for assistance in performing a step--"Follow the instructions." (Except in PMI where the instructor gave individuals assistance when requested.)

b. Removal of rear trigger housing assembly pin (which should not have been done). The instructor replaced the trigger housing assembly with one not disassembled and cautioned the student not to remove the rear pin. (Although the rear trigger housing assembly pins were painted red and each section was told before training and testing not to remove the red pin, one or two students would do so each day.)

c. Weapon malfunction--Few cases of weapon malfunction were encountered, and these were due to the student's applying force. The instructor would free the part with a screwdriver and tell the student to continue assembly or disassembly.

The two Linear Programs and the Booklet form of the Audio-Visual program were self-paced. The times of completion of the first student and the last student were recorded for these training sessions. Many of the frames of the Linear Program did not require written responses. The groups taking the Linear Program with Answer Sheet were instructed to check the Answer Sheet when they had completed frames not requiring written responses.

TABLE 3

TRAINING TIMES FOR SELF-PACED MODES OF PRESENTATION

Mode	Content	Training Times in Minutes		
		First Student	Last Student	Mid-Time
LPB	D&A	22	58	40
	Do	8	32	20
	Ao	11	37	24
LPB w Answer Sheet	D&A	25	60	42.5
	Do	12	37	24.5
	Ao	17	41	29
A/V Booklet	D&A	27	53	40
	Do	11	30	20.5
	Ao	13	34	23.5

The Audio-Visual program was presented lock-step as was the Present Method of Instruction. The A/V subjects were directed to look up when they were ready for the next slide. Upon signal from the instructor-observer, the sound projector operator advanced to the next slide. The times of these three modes are therefore related to the times in the last student column above. It should be noted that in the A/V program there did exist a forcing pressure since the class was waiting after each slide for the slowest student.

TABLE 4

TRAINING TIMES FOR LOCK-STEP
MODES OF PRESENTATION

Mode	Content	Training Time in Minutes
A/V	D&A	51
	Do	28
	Ao	26
PMI_U	D&A	42
(S/Sgt. Bridges)	Do	31
	Ao	33
PMI_I	D&A	37
(S/Sgt. Smith)	Do	16
	Ao	23

The second PMI groups were included to check whether substantial differences could be attributed to the special attention given Sgt. Smith in aligning the PMI material with the content of the instructional programs. Both instructors had had over two years experience and are considered to be highly competent by their supervisors.

Criterion Test

The criterion test consisted of the subjects actually disassembling and then assembling the carbine. Two test scores, time and assists, were taken. The time score was taken in two parts:

a. Time required for disassembly.
b. Total time required for disassembly plus assembly.

Time for assembly only was obtained by subtraction.

An assist was scored when the trainee was unable to perform a step, and raised his hand. A proctor would then perform the step for the subject, and mark the subject's record sheet accordingly. The record sheets were standard IBM answer sheets. The list of steps in disassembly and assembly, as agreed upon by the expert instructors in conjunction with the on-site experimenter, is given in Appendix 1.

Testing, like training, was done in groups of about 30 subjects. Pilot runs on the test indicated that one proctor for every five or six subjects would be sufficient to prevent objectionably long waiting periods for any subject. This ratio of proctors was provided during testing.

The instructions to proctors and to subjects (Appendix 4) give the details of the test administration. The on-site experimenter read the student instructions to each group. The classroom and weapons used were pre-checked to minimize the possibility of variables in conditions during the test or malfunctions of weapons. All testing was done between 0700 and 0845 in the morning of the second day after training. No subject had an opportunity to disassemble or assemble a carbine between training and testing.

In order to familiarize the proctors with the testing procedure, the brief training program, outlined in Table 5 was prepared and presented. A testing "dry run" was made on a group of subjects not used elsewhere in the study.

TABLE 5

OUTLINE OF TRAINING OF INSTRUCTOR-PROCTORS IN TEST ADMINISTRATION

Subject	Method	Time (Minutes)
1. Study Objectives	Lecture-discussion	:10
2. Test Description	Disassembly-Assembly Performance	:20
3. Test Administration	Lecture-Discussion	:30
4. Definition of Terms	Demonstrations	:30
5. Conduct of Test & Scoring	Demonstration	:30
6. Practice of Scoring	Paired Team Practice	:50
7. Summary Discussion	Lecture-discussion	:10
	Total	3:00 hours

DATA ANALYSIS

The following analyses were performed:

I. 3 x 7 cell analysis of variance; (NT_1 omitted);

Time score: n = 48 per cell; N = 1008.

II. Same as I, using Assist scores.

III Produce-Moment Correlations between the several test scores and AFQT, Educational level, and four separate aptitude scores.

The number of subjects on which data were obtained was 1,366. Of these, 37 had to be dropped from the analysis of variance because of incomplete data. The most common type of missing data was the time score at the completion of disassembly, resulting mainly from subjects failing to raise their hands for a disassembly check and time recording.

The resulting smallest number of subjects in any cell was 48. For convenience in analysis, randomly-selected subjects were dropped from other cells to bring the number of subjects in each cell to 48.

Tests of the significance of the difference between selected pairs of means were done after significant F ratios were obtained in the analysis of variance. The analysis of variance was done without the NT_1 data. Since NT_1 and NT_2 data were taken on the same subjects (NT_1 was the first time they took the test, and NT_2 the second), the NT_1 and NT_2 scores would be correlated. Since the NT_2 data consists of the test scores of the subjects "trained" by taking the test (NT_1), the NT_2 data was included in the "Mode" variable.

Correlations between various test scores and Air Force entry test scores and educational level were computed.

STATISTICAL RESULTS

Analysis of Variance

Analysis I is summarized in Table 6. It shows the following significant F ratios on time scores at the .001 point: Content, Mode, Content x Mode interaction, Task (assembly test scores vs. disassembly test scores), Task x Content interaction, and Task x Mode interaction. The second-order interaction of Task x Content x Mode has an F ratio significant at the .05 level.

Analysis II is summarized in Table 7. This analysis of Assist scores shows similar results to Analysis I (significant F ratios at .001) for Content, Content x Mode interaction, Task (assembly test score vs. disassembly test score), and Task x Content interaction. Different results were obtained for Mode (significant at the .025 point) and for Task x Mode interaction which is not significant. The second order interaction of Task x Content x Mode is also similar, being significant at the .05 point.

Differences Between Selected Means

Tables 8 through 15 present the results of tests of significance between means of selected cells.

Tables 8 and 9 pertain to the effects of the independent variable "Mode of Training" on Time and Assist scores, respectively.

Tables 10 and 11 pertain to the effects of the independent variable "Content" on Time and Assist scores, respectively.

Tables 12 and 13 pertain to the effects of "Mode of Training" on Time and Assist scores, respectively, for the separate "Disassembly" and "Assembly" scores on the criterion test.

Tables 14 and 15 pertain to the effects of "Content" on Time and Assist scores, respectively, for the separate "Disassembly" and "Assembly" scores on the criterion test.

Correlations (Analysis III)

Table 16 shows the correlations between various personal attributes of the subjects used in the study, and the various scores obtained on the criterion test.

Distribution of Assists

Table 17 shows the number of assists rendered during testing, by Mode of Training, for each step of the disassembly and assembly procedure. Two sets of totals across Modes are given, one including the NT_1 group, and one set of totals that does not include the NT_1 group.

TABLE 6

SUMMARY OF ANALYSIS OF VARIANCE - TIME IN SECONDS -
3 x 7 DESIGN - 48 Ss PER CELL

Source	df	MS	F	p
Between Ss	1007			
Content of Training (C)	2	827,527.6	52.24	.001
Mode of Training (M)	6	193,356.1	12.21	.001
C x M	12	61,222.7	3.86	.001
Error (b)	987	15,841.1		
Within Ss	1008			
Criterion Task (T)	1	9,364,055.4	856.62	.001
T x C	2	358,215.8	32.77	.001
T x M	6	63,151.5	5.78	.001
T x C x M	12	20,515.3	1.88	.05
Error (w)	987	10,931.4		
Total	2015			

TABLE 7

SUMMARY OF ANALYSIS OF VARIANCE - ASSISTS -
3 x 7 DESIGN - 48 Ss PER CELL

Source	df	MS	F	p
Between Ss	1007			
Content of Training (C)	2	21.1076	8.74	.001
Mode of Training (M)	6	5.8750	2.43	.025
C x M	12	6.9462	2.88	.001
Error (b)	987	2.4135		
Within Ss	1008			
Criterion Task (T)	1	303.3353	194.73	.001
T x C	2	21.3576	13.71	.001
T x M	6	1.6015	1.03	-
T x C x M	12	2.7367	1.76	.05
Error (w)	987	1.5577		
Total	2015			

TABLE 8

RANK OF EACH MODE OF PRESENTATION BY
MEAN TIME (SECONDS) TO COMPLETE THE CRITERION TASK

Rank	Mode	Mean Time (Seconds)
1	PMI_1	415.52
2	LPB	419.30
3	AV	429.79
4	NT_2	446.66
5	AVB	462.47
*		
6	PMI_U	515.08
7	LPBA	552.65
*		
8	NT_1	728.65

Critical Difference (.05) = 41.3

Significant Differences:

1. PMI_1 and LPB are significantly better than AVB, PMI_U, LPBA
2. At * in ranking

TABLE 9

RANK OF EACH MODE OF PRESENTATION BY MEAN NUMBER OF ASSISTS RENDERED DURING PERFORMANCE OF THE CRITERION TASK

Rank	Mode	Mean Number of Assists
1	LPBA	1.2153
2	AV	1.5417
3	PMI_U	1.6458
4	PMI_I	1.6458
5	NT_2	1.8125
6	LPB	1.8750
7	AVB	2.1250
*		
8	NT_1	3.8819

Critical Difference (.05) = .510

Significant Differences:

1. LPBA is significantly better than NT_2, LPB, AVB
2. AV is significantly better than AVB
3. At * in ranking

TABLE 10

RANK OF EACH TRAINING CONTENT BY MEAN TIME (SECONDS) TO COMPLETE THE CRITERION TASK

Rank	Content	Mean Time (Seconds)
1	Ao	407.89
2	D+A	439.12
3	Do	542.20

Critical Difference (.05) = 27.0

Significant Differences

1. Ao is significantly better than D+A and Do
2. D+A is significantly better than Do

TABLE 11

RANK OF EACH TRAINING CONTENT BY MEAN NUMBER OF ASSISTS RENDERED DURING PERFORMANCE OF THE CRITERION TASK

Rank	Content	Mean Number of Assists
1	D+A	1.4345
2	Ao	1.5506
3	Do	2.0982

Critical Difference (.05) = .333

Significant Differences

D+A and Ao are significantly better than Do.

TABLE 12

MODE X TASK: RANK ORDER OF MEAN TIME SCORES IN SECONDS ON SEPARATE "DISASSEMBLY" AND "ASSEMBLY" TEST SCORES

"Disassemble" Task			"Assemble" Task		
Rank	Mode	Mean Time (Seconds)	Rank	Mode	Mean Time (Seconds)
1	LPB	138	1	PMI_I	260
2	AV	149	2	AV	281
3	AVB	151	3	LPB	281
4	NT_2	152	4	NT_2	294
5	PMI_I	155	5	PMI_U	304
*			6	AVB	311
6	LPBA	186	*		
7	PMI_U	211	7	LPBA	367
*			*		
8	NT_1	301	8	NT_1	428

Critical Difference (.05) = 27

Significant Differences

Only at * in ranking

Critical Difference (.05) = 27

Significant Differences

1. PMI_I is significantly better than NT_2, PMI_U, AVB, LPBA
2. AV is significantly better than AVB, LPBA
3. At * in ranking

TABLE 13

MODE X TASK: RANK ORDER OF MEAN NUMBER OF ASSISTS ON SEPARATE "DISASSEMBLY" AND "ASSEMBLY" TEST SCORES

"Disassemble" Task			"Assemble" Task		
Rank	Mode	Mean Number of Assists	Rank	Mode	Mean Number of Assists
1	LPBA	.236	1	LPBA	.979
2	AV	.437	2	AV	1.104
3	NT_2	.479	3	PMI_U	1.139
4	PMI_I	.493	4	PMI_I	1.153
5	PMI_U	.507	5	NT_2	1.333
6	AVB	.535	6	LPB	1.347
7	LPB	.578	7	AVB	1.590
•			•		
8	NT_1	1.618	8	NT_1	2.264

Critical Difference (.05) = .33

Significant Differences

1. LPBA is significantly better than LPB
2. At • in ranking

Critical Difference (.05)= .33

Significant Differences

1. LPBA is significantly better than NT_2, LPB, AVB
2. AV is significantly better than AVB
3. At • in ranking

TABLE 14

CONTENT X TASK: MEAN TIME IN SECONDS TO COMPLETE "DISASSEMBLE" OR "ASSEMBLE" PARTS OF THE CRITERION TASK FOR THE THREE TRAINING CONTENTS

Content	Part of Criterion Task	
	Disassemble	Assemble
D+A	162.2	276.9
Do	176.3	365.8
Ao	151.2	256.7

Significant Differences (Crit. Diff. .05 = 18)	Ao is significantly better than Do	1. Ao is significantly better than D+A and Do 2. D+A is significantly better than Do

TABLE 15

CONTENT X TASK: MEAN NUMBER OF ASSISTS RENDERED DURING COMPLETION OF THE "DISASSEMBLE" AND "ASSEMBLE" PARTS OF THE CRITERION TASK FOR THE THREE TRAINING CONTENTS

Content	Part of Criterion Task	
	Disassemble	Assemble
D+A	.43	1.00
Do	.45	1.64
Ao	.49	1.06

Significant Differences (Crit. Diff. .05 = .21)	None	Ao and D+A are significantly better than Do

TABLE 16

CORRELATIONS BETWEEN CHARACTERISTICS OF SUBJECTS AND VARIOUS CRITERION TEST SCORES

All subjects were used on which complete data were available, except NT_1 subjects. N = 1164.

Aptitudes from AQE

AFQT	ED.LEVEL	MECH.	ADMIN.	GENERAL	ELECT.	TEST SCORES
- .25	$\boxed{.01}$	- .29	$\boxed{- .04}$	$\boxed{- .06}$	- .18	Disassembly Time
- .25	- .08	- .25	- .12	- .14	- .21	Assembly Time
- .30	$\boxed{- .07}$	- .32	- .12	- .14	- .24	Dis + Assem Time
- .14	$\boxed{.00}$	- .15	$\boxed{- .03}$	$\boxed{- .02}$	- .11	Disassembly Assists
- .20	$\boxed{.01}$	- .25	$\boxed{- .03}$	$\boxed{- .05}$	- .16	Assembly Assists
- .22	$\boxed{.01}$	- .26	$\boxed{- .04}$	$\boxed{- .05}$	- .17	Dis + Assem Assists

Boxed figures are <u>not</u> significant.

TABLE 17

NUMBER OF ASSISTS FOR EACH STEP, BY MODE OF TRAINING, AND TOTALS

Task Steps	Mode of Training								All Modes	
	AV	AVB	LPB	LPBA	PMI_U	PMI_I	NT_1	NT_2	INCL. NT_1	EXCL. NT_1
1	8	10	5	2	5	7	16	2	55	39
2	14	14	11	8	16	13	46	17	139	93
3	0	1	0	0	1	0	9	3	14	5
4	0	0	0	0	0	0	0	0	0	0
5	0	2	1	0	0	0	3	1	7	4
6	8	1	5	1	2	6	34	3	60	26
7	1	1	1	1	3	2	47	1	57	10
8	1	0	0	8	1	6	22	3	41	19
9	5	3	1	0	4	2	7	1	23	16
10	1	1	1	4	2	2	6	2	19	13
11	5	14	9	3	10	10	21	8	80	59
12	5	10	8	0	5	7	19	5	59	40
13	9	14	14	6	12	8	27	8	98	71
14	9	15	9	1	8	10	21	6	79	58
15	1	1	4	2	1	3	7	3	22	15
16	0	1	6	2	3	0	6	4	22	16
17	0	1	6	1	1	9	5	3	26	21
18	0	0	5	1	1	2	2	3	14	12
19	1	2	6	1	2	4	7	3	26	19
20	17	15	8	10	11	13	31	9	114	83
21	6	14	13	9	6	26	32	15	121	89
22	13	26	28	23	19	19	47	28	203	156
23	16	22	30	23	8	15	34	34	182	148
24	9	25	6	12	9	20	18	11	110	92
25	60	44	52	40	41	53	79	67	436	357
26	16	23	23	5	20	13	24	15	139	115
27	9	17	18	6	8	8	17	17	100	83
28	5	22	19	3	3	8	17	15	92	75
29	7	1	4	2	2	3	11	5	35	24
30	1	0	3	0	0	2	5	2	13	8
31	0	1	0	1	3	1	3	1	10	7
32	2	3	1	1	1	0	12	2	22	10
33	9	9	7	3	7	1	29	5	70	41
34	0	4	0	3	4	1	10	3	25	15
35	1	3	1	0	3	5	3	1	17	14
36	0	3	4	5	4	2	3	2	23	20
37	3	1	2	0	5	9	10	7	37	27
38	2	4	0	2	4	1	8	3	24	16
39	4	7	7	4	4	3	10	6	45	35
40	7	1	0	19	3	4	18	7	59	41
Totals	255	336	318	212	242	298	726	331	2718	1992

DISCUSSION OF RESULTS

Mode of Training

No one mode of training was clearly superior or inferior to the other modes (Tables 8 and 9). Every mode produced performance superior to the performance of the NT_1 group. On time scores, PMI_I, LPB, AV, NT_2, and AVB were all superior to PMI_U and LPBA. PMI_I and LPB were also significantly better than AVB, PMI_U, and LPBA.

The assist scores reveal LPBA was significantly better than NT_2, LPB, and AVB.

Four findings are of interest.

1. The reversal of positions of LPB and LPBA on Time and Assist scores. On the time score, LPB is significantly better than LPBA. On assists, however, LPBA is significantly better than LPB. One can only speculate as to cause. Possibly the requirement to attend to an answer sheet resulted in more careful attention to the instructions, resulting in better learning and fewer assists on the test. It is also possible, of course, that a spurious difference in emphasis crept into the instructions, with the subjects in one group feeling more free to ask for assists.

2. Taking the criterion test without being given any special instruction (NT_1) resulted in test scores on the second taking of the test (NT_2) as good as many of the other modes of training. On time scores, this treatment resulted in test scores as good as any mode of training. On assists, the no-training group, the second time they took the test (NT_2) did as well as any other group except the group trained on LPBA. This finding suggests that for this task, trial-and-error learning with assistance provided when requested, was virtually as effective as any other training.

This result is probably a function of the simplicity of the task. The task objective was always quite clearly before the subject. The next step to be taken is not difficult for the subject to determine.

The finding, of course, would have to be checked on other, more complex tasks, before it could be given much credence. Even if the result were to hold up, its practical applicability to training would probably be limited to tasks in which the subject would be unlikely to damage the equipment by using erroneous procedures or by forcing any of the parts apart or together.

On the other hand, however, if it were found that this type of instruction were reasonably effective for certain types of tasks

it might be possible to use as "instructors" personnel who were technically qualified but who had no special training or skills in teaching methods.

3. The AVB mode is one of the less effective modes, both on time and assist scores. On time it is better than only PMI_U and LPBA. On assists it is better than only NT_1. This is of special interest because the AVB program is almost exactly the same material as the AV program, but does not give as good results. This, coupled with the observations of the experimenter during development of linear program materials is noteworthy. The experimenter noted that concurrent pictorial and written stimuli without particular dominance of one over the other led to confusion in response. This situation was corrected on the linear programs, but not on the AV program. The test scores of the AVB mode support the hypothesis that this kind of simultaneous presentation of pictorial and written stimuli is undesirable.

4. The PMI_U mode of instruction in this study is most nearly representative of typical Air Force instruction. It cannot be represented as truly typical, however, since the instructor was probably more aware of the objectives of the instruction than the typical instructor; he was certainly more experienced, and he was probably better motivated because he knew he was part of an experiment. These factors suggest that criterion task performance of the PMI_U group may be higher than would be obtained in a completely representative situation.

Furthermore, the typical lecture-demonstration mode probably cannot be relied upon to give consistent results due to the great variability among instructors. The greater uniformity of presentation offered by the programmed instruction modes can reasonably be expected to produce more consistent levels of performance in the trainees.

These two conditions suggest that the instructional program may have advantages for Air Force training which are not apparent from this study.

Content of Training

The interesting finding here is that training on Assembly only (Ao) was at least as effective as training on Disassembly plus Assembly (D+A), on both Time and Assist test scores. This, despite the fact that the Ao training is substantially shorter than D+A. (See Tables 3 and 4)

The relative effectiveness of the Ao training is emphasized in the "interaction" statistics. Tables 14 and 15 show that Ao was at least as effective as any other training content, even on the "Disassembly" part of the criterion task. That is, training on assembly of the carbine (Ao content) produced as good performance on disassembling the carbine during the criterion task as did training on disassembly of the carbine (Do content), and as good performance as training on both disassembly and assembly (D+A content).

The implication, if this finding holds up under further test, is that training times might be shortened with little or no performance degradation. In this study, the saving is in minutes. But similar effects might be found that could reduce training time by hours or even days.

The simplicity of the task used is, of course, a limitation on the results. The suggestion is clear, however, that this effect be tested again using a more complicated task.

Correlations with other Data

These findings are incidental to the study, but were computed because the data were available on the subjects. We thought that quantitative relationships between aptitude scores and a particular task would be useful.

Table 16 shows the correlations between various scores on the criterion test and measures of subject characteristics. Mechanical Aptitude and AFQT scores are the best predictors of ability to learn and perform this task, although neither gives a particularly high correlation with any test score. The highest correlation is between Mechanical Aptitude and Total Time Score, where r = - .32. The correlations with Assists are subject to some attenuation, however, because of restriction in range of the number of assists required by the subjects. Correlations are negative for a positive relationship, since higher time and assist score indicate a lower level of performance, while the aptitude scores increase with higher aptitudes.

Other results: Programming Performance Tasks

Early in the try-out and revision stages of the development of the additional portions of the Linear Program, problems in the concurrent use of verbal and pictorial stimuli became apparent. Subjects became confused when presented with both verbal and pictorial stimuli in the same frame, particularly when neither one was clearly dominant. The response was delayed. The subject scanned the verbal, then the pictorial stimuli, then the weapon, and often repeated the cycle several times. On several occasions the subject pushed the program aside and began a trial-and-error manipulation.

Frames #117 and #128 were first tried with drawings to illustrate the position of the slide and the motion necessary to free the rear lug. They produced random behavior and manipulation of the slide. Unfortunately, the random behavior sometimes was successful. After the removal of the drawings, subjects performed as desired with the appropriate movements. As a further example, the drawing on Frame #129 was enlarged until it dominated the frame before it produced a satisfactory level of results. Since this frame required both pushing and turning, the subjects were not always successful on the first try. Frame #130 was added, redirecting them over the sub-sequence. All try-out subjects behaved as desired on the second try.

An additional observation was made during the development of the Assembly Only Linear Program. The most complex performance behavior required is the positioning and replacement of the operating slide. The operating slide must be correctly positioned with relation to both the bolt and the grooves on the barrel before it can be turned into place. This requires turning and push-pull movement of the right hand in coordination with a holding movement with the left hand and fingers. The initial frame tried was similar to Frame #144 except that it contained verbal instructions as to the position of the slide and its relationship to the bolt and grooves. Only two of the first five try-out subjects negotiated this frame and one of these could not repeat the behavior, indicating that his success had been by chance. The complexity of the manipulation was reduced by adding preliminary frames (Frames #140 through #143) depicting the relationship between the parts in a series of static steps. The action frame was then reduced to the barest simplicity. (Frame #145). Try-outs of this sequence produced the desired results on the first try for five out of seven subjects. The other two were successful when redirected through the sequence. (Frame #146) All could repeat the performance without assistance.

The problem of providing reinforcement in performance skills programs was uppermost in the mind of the programmer during the development of these frames. It did not appear appropriate to require written responses to most frames. The effect of apparent but unconfirmed success as the weapon was disassembled or assembled step-by-step was hypothesized to be sufficiently strong and immediate to produce learning. The try-out results confirmed this assumption. Subject remarks--"I see," "That's how it goes," "Now what's next?" "Simple."--were the most common. Occasionally a subject would query "Is this right?" or "O.K?" but continue confidently without being answered. It should be noted that the subjects had before them the table on which each part of the disassembled weapon was depicted and labeled. In addition the subjects taught assembly only had seen and handled an assembled carbine before instruction. The terminal objective was thus apparent and also may have reinforced their step-by-step progress.

CONCLUSIONS

On the basis of the rather limited experience gained in the conduct of this study, the following conclusions are offered.

1. Where the capability exists for the subject to perform the manipulative task under the guidance of the instructional program as part of the training regimen, no mode of training studied is consistently and significantly better than any other of the modes. This conclusion may change as a function of task length or complexity.

2. Training on how to disassemble makes no detectable contribution to the ability of the subject to disassemble or assemble the item if he has been trained to assemble the item. This conclusion may change as a function of task complexity, or may not be valid if actual manipulation of the item is not part of the training.

3. Equally prominent verbal and pictorial stimuli in the same frame tend to compete for the subject's attention, reducing the effectiveness of the frame. Either the verbal instructions or the illustration should be clearly dominant.

4. Complex manipulative movements can be programmed as a series of static positions followed by a simple directive frame.

5. Formal confirmation of subject response from the program is not required if the terminal objective is in the subject's repertory and if the training includes actual performance of the task.

SUGGESTED FUTURE RESEARCH

1. Although the results of this study did not indicate one mode of training to be greatly superior to another, this finding is severely limited by the simplicity and brevity of the task studied and the training given. It is hypothesized that for training of several hours duration, the audio-visual mode would result in significantly better learning. Three reasons are given:

   a. Audio-visual impinges on two sense modes.
   b. It does not depend on the subject's reading comprehension.
   c. It would hold subject interest better than hours of reading.

   It is suggested that an audio-visual mode be compared with an all-visual program for training on a complex task.

2. This study included in the training actual manipulation of the item to be disassembled and assembled, under guidance of the program. In many training situations, each subject cannot have his own device on which to work. What modes of training, and characteristics within those modes, would result in greatest transfer to the criterion task, if performance of the criterion task could not be included as part of the training?

3. Investigate the relative effectiveness of audio-visual versus all visual versus conventional training films for various parts of basic training, or for training of non-technical or low level personnel. It is hypothesized that the audio-visual mode would be superior to all visual because it does not depend on reading ability, and superior to conventional films because it is a learning program rather than a filmed illustrated lecture.

4. Develop or borrow from industrial engineering a taxonomy of dynamic movement actions, and develop and test rules for programming these effectively with static frames.

5. Test, on a more complex task, the finding that training on assembly only is as effective as training on assembly plus disassembly.

6. In this study the program was short and progress toward the terminal objective was easily perceived. In one respect the approach in this study employed the Mathetic principle advanced by Gilbert in that the subjects all were aware during every step of the relationship of that step to the terminal objective. Many, if not most, maintenance activities involving disassembly and assembly are not so simple. Must the complex and lengthy disassembly and assembly tasks be taught from the terminal objectives backward in order to insure learning? Will a sequence not leading to a pre-taught or apparent terminal objective produce learning?

7. Investigate the variability of the results obtained from typical lecture demonstration instruction. This should be done by comparing the results obtained by different instructors and at different sessions using the same instructor. These results should be compared to the variability obtained by use of the LPB and the AV modes. It is hypothesized that the results from the AV and LPB modes would be more reliable than the typical instruction.

8. The LPB and the LPBA were self-paced. The AV program used in this experiment was a lock-step type of program. A comparison should be made to determine if a self-paced AV program would be more effective. The time required for each subject to complete his training should be recorded.

9. In future experiments, results from high, medium and low aptitude groups should be isolated. It might be found that the effectiveness of various modes differ for those aptitude levels.

APPENDIX I

List of Performance Steps

DISASSEMBLY

Performance Items:

1. Loosen front band assembly screw.
2. Depress front band assembly spring.
3. Slide front band assembly forward.
4. Remove hand guard.
5. Remove barrel and trigger assembly group from stock.
6. Disengage operating slide spring and guide rod from front guide rod recess.
7. Remove spring and guide rod from spring well.
8. Separate spring and guide rod.
9. Remove trigger housing pin.
10. Remove trigger assembly.
11. Pull operating slide bank to rear disassembly notch in the receiver.
12. Move slide forward 1/4 inch.
13. Twist operating slide across top of receiver.
14. Take slide off.
15. Grasp operating lug of the bolt and turn it up.
16. Slide it back 1/4 inch behind the locking lug recess.
17. Lift front end of bolt up to 45 degree angle.
18. Rotate bolt 1/4 turn to the left.
19. Lift the bolt out of the receiver.

Disassembly complete

ASSEMBLY

20. Insert bolt into receiver 45 angle.

21. Lower bolt into receiver.

22. Rotate bolt to the right 1/4 inch behind locking lug recess.

23. Slide bolt all the way to rear.

24. Put slide under barrel.

25. Match slide (rear) comming recess with bolt lug.

26. Match front slide lug to barrel recess.

27. Rotate slide into recess.

28. Move slide all the way forward.

29. Engage trigger housing lugs in slots on rear of receiver.

30. Move trigger housing forward until pin hole is clear.

31. Insert trigger housing pin.

32. Put spring and guide rod together.

33. Insert spring and guide rod into well in the receiver.

34. Compress spring and insert guide into the recess in the operating slide.

35. Engage barrel and trigger assembly with recess on receiver plate of stock.

36. Lower barrel and receiver assembly into place in stock.

37. Engage metal tab of hand guard in socket in the receiver.

38. Lower hand guard into place.

39. Push front band over locking spring.

40. Tighten screw.

Assembly complete

APPENDIX II

LESSON PLAN: Conventional Classroom Instruction

Training equipment: One M-1 Carbine; student; one table w/parts; templates

Objective	Method: Explanation	Method: Demonstration	Method: Student Activity
I. Introduction			
A. Instructional Objectives:	1		
To learn disassembly To learn assembly			
Method of Instruction:			
Explanation Demonstration Student Activity			
B. Need for knowledge:	1		
To correct minor troubles Field care to insure functioning			
C. Tools required	1		
Any one of the following: Coin, dog tag, cartridge case, screw driver			
II. Body of Instruction			
A. Clear the weapon	1	2	3
B. Loosen front band retaining screw	1	2	3
C. Compress spring	1	2	3
D. Slide band forward	1	2	3
E. Remove hand guard	1	2	3
F. Raise barrel 45^{o}	1	2	3

Objective	Explanation	Demonstration	Student Activity
G. Remove barrel	1	2	3
H. Identify trigger housing assembly and pin	1	2	3
I. Remove pin	1	2	3
J. Slide THA to rear	1	2	3
K. Identify lugs	1	2	
L. Identify operating slide spring and guide rod	1	2	
M. Caution about spring	1		
N. Pull OSS and GR back and remove			
O. Identify operating slide lugs			
P. Identify Bolt relation to Op slide	1	2	3
Q. Remove Op slide	1	2	3
R. Identify bolt lugs	1	2	3
S. Remove bolt	1	2	3

Disassembly Complete

Instructors check each student table.

A.A. Replace bolt	1	2	3
B.B. Position Op slide and bolt	1	2	
C.C. Caution about use of force	1		
D.D. Replace Op slide	1	2	3
E.E. Identify spring well, then position the barrel assembly and Op slide			
F.F. Insert spring and rod in well	1	2	3
G.G. Compress spring and insert in Op slide recess	1	2	3
H.H. Trigger housing lugs refresher	1		
I.I. Replace trigger housing	1	2	3

Objective		Explanation	Demonstration	Student Activity
J.J.	Insert pin from right side	1	2	3
K.K	Identify both the lug on rear of receiver and the recess on recoil plate	1	2	
L.L	Mate lug and recess and lower barrel assembly into place in the stock	1	2	3
M.M.	Replace hand guard		2	3
N.N.	Slide front band assembly over locking spring	1	2	3
O.O.	Caution to engage firmly	1		
P.P.	Tighten screw	1	2	3

<u>Assembly complete, now function check</u>

III. Closing

A. Function check:	1		
Slide back, safety on, check trigger, safety off, trigger check, safety on, weapon down.		2	

APPENDIX III

Answer Sheets for LPBA Mode

Disassembly Answer Sheet

Place a check (✓) in the space when you have done what the program says. If an answer is required, fill in the blank spaces.

75. __ __ __ __ __ _____.

77. _____ ________.

79. _____. (check)

81. ____ ________.

83. _____.

85. _____.

87. ______ ______ _______.

89A ______.

91 __________ _________.

93. ________.

95. ______ ______ _____.

A. ____.

97. ______ ____________.

99. ______ __________.

101. ___.

103. ___.

105. ______ ________.

A. ______ ________.

107. ______ ________.

109. ________ ________

A. ________.

111. ________.

A. ______________.

113.1. _____________________

2. _____________________

3. _____________________

115. ___ _____ ____________.

117. _______ _____________

119. _____. (check)

120. _____.

121. _____.

122. _____.

123. _____.

124. _____.

125. _____.

126. _____.

127. _____.

128. _____.

129. _____.

130. _____.

131. _____.

132. _____. (yes or no)

133. _____.

134. _____.

135. _____.

Assembly
Answer Sheet

Place a check (✓) in the space when you have done what the program says. If an answer is required, fill in the blank spaces.

136. _____.

137. _____.

138. _____.

139. __________ (yes or no)

140. _____.

141. __________ (yes or no)

142. __________ (yes or no)

143. __________ (yes or no)

144. _____.

145. _____.

146. _____.

147. _____.

148. _____.

149. ________ ______ __________

151. ______________ ___________

153. ___ _____ _____ _____ _____

155. ________ _______ __________

157. ________ _____________

159. ________ ______ __________

APPENDIX IV

Instructions for Test Administration

A. Instructions to Proctors:

1. General

a. The task performance will be measured by recording the number of ASSISTS on the record sheet of each student.
b. The proctor, not the student, will record the number of ASSISTS.
c. The proctor, not the student, will record the times:
(1) Upon completion of disassembly.
(2) Upon completion of assembly.

2. Procedures:

a. ASSIST - The disassembly contains 19 performance items, the assembly contains 21 performance items. When a student raises his hand for an ASSIST the proctor will:
(1) Identify the performance item failed by the student.
(2) Perform that item and say "Now you go ahead with the disassembly. (or assembly)
(3) Score the answer sheet opposite the appropriate item number by making a mark in the A column.

b. Time record: Upon disassembly, when the student raises his hand, the proctor will:
(1) Check to determine if disassembly is complete - if not - perform the item and record an ASSIST as in 2.a (1) (2) b above. If disassembly is complete but parts are not on the templates say: "Put the parts on the right places." When parts are in the right places say: "OK. Now assemble the weapon." Then record the clock time to the nearest 5 seconds in the space numbered 1. under SCHOOL on the students answer sheet.
(2) When the student raises his hand for completion of assembly the proctor will:
(a) Examine the weapon for improper assembly. If improper assembly is found the proctor will disassemble to the appropriate item - perform that item and say, "Now you go ahead with the assembly." The proctor will then record an ASSIST on the assembly item failed.
(b) If the weapon has been properly assembled as determined by examination and function check, the proctor will record the clock time to the nearest 5 seconds in the space numbered 2. under CITY on the students answer sheet.

B. Instructions to Students are to be read slowly in a loud clear voice:

1. Introduction: "During this period you will disassemble and assemble the M-1 Carbine. On your table you see a Carbine and a record sheet. The record sheet looks like a test answer sheet but it isn't. Only the instructor will make entries on the record sheet. The entries he makes will help us learn some things about the methods of teaching disassembly and assembly tasks."

2. Instructions about the record sheet.

"Now print your name where the record sheet says NAME. Then put your serial number where it says DATE. Then put your squadron and flight where the sheet says SCHOOL. Remember Print. If you have a problem or question raise your hand and an instructor will give you an ASSIST." //Time lapse// "Everyone finished? Now place the record sheet on the top center of your table. You will not make any more entries on it, so put your pencil back in your pocket."

3. Procedure:

"Each row has an instructor. Your instructor is at the rear of your row. Turn now and look at him. While you are disassembling and assembling your weapon he is available to give you an ASSIST. What do you do when you want an ASSIST?" (Pause for responses) "That's right, you raise one hand." "When your weapon is disassembled you must put each part on the appropriate drawing on your table and raise both hands." "What do you do when you have completed disassembly?" (pause) "That's right - place the parts on the drawings and raise both hands. Your instructor will then check your table and will tell you when to start assembling your carbine." "During assembly the procedure is the same. Raise one hand for an ASSIST and raise both hands when you have finished." "Now one more point and then I will give you the signal to start. Don't hesitate to ask for an ASSIST when you need it, because it is from the record of assists needed that we will learn how to improve this kind of training in the Air Force."

"Ready?"

"Start"

Administrator plugs in clock which has been set with minute and second hand on 12 o'clock.

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Folley, John D., Jr.
Bouck, Aubrey J.
Foley, John P., Jr.

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13 ABSTRACT

Approximately 1300 basic military trainees were used in a 3 x 7 factorial study of modes and content of training on a manipulative performance task, the assembly and disassembly of the M1 carbine. The modes of training included lecture-demonstration, a printed linear program with or without an answer sheet, and an audio-visual program presented by an audio-visual device or by a printed booklet. Also evaluated was a condition in which the trainees tried to perform the final task and were assisted as required. The content of the training was varied by providing training on assembly only, or disassembly only, or both. The final criteria were the time and the number of assists required to disassemble and assemble the M1 carbine. Although the modes of training differed significantly, the rankings were very different on the two criteria. No mode of training seemed clearly superior to the other modes. The audio-visual program presented in the printed booklet seemed somewhat inferior. Training on only the assembly of the carbine resulted in as good performance as training on both assembly and disassembly. The findings probably can be generalized only to relatively simple procedural type tasks. Replication of the study with more complex performance tasks is recommended.

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